CLAIMS

What is claimed is:

1. A conductive element for a fuel cell comprising;

a first conductive sheet having a first surface that confronts a second surface of a second conductive sheet;

wherein said first and said second surfaces are overlaid with an electrically conductive primer coating providing corrosion protection;

wherein said first and said second coated surfaces are joined to one another at one or more contact regions by an electrically conductive adhesive which together with said primer provides a target bondline resistance across said first and said second sheets respectively which is lower than a comparative contact resistance of said adhesive without said primer; and said target bondline resistance is maintained for a time duration greater than a time duration during which said comparative contact resistance is maintained.

2. The conductive element according to claim 1, wherein said target bondline resistance is measured across said first and second sheets through said adhesive and said primer and is less than 20 mOhms-cm^2 after exposure to fuel cell operating conditions in excess of 500 hours.

3. The conductive element according to claim 1, wherein said target bondline resistance is measured across said first and second sheets through said adhesive and said primer and is less than 5 mOhms-cm^2 after exposure to fuel cell operating conditions in excess of 6000 hours.

4. The conductive element according to claim 1, wherein said first and said second conductive sheets comprise an electrically conductive metal.

5. The conductive element according to claim 1, wherein said first and said second conductive sheet comprise an electrically conductive polymeric composite.

6. The conductive element according to claim 1, wherein said electrically conductive primer coating has a contact resistance of less than or equal to about 20 mOhms-cm^2 under a compressive force of about 1400 kPa.

7. The conductive element according to claim 1, wherein said primer coating comprises a matrix of a binder and a plurality of electrically conductive particles.

8. The conductive element according to claim 7, wherein said binder is a polymeric resin and is selected from the group consisting of: polyamide imide, polyimide, poly vinyl ester, and mixtures thereof.

9. The conductive element according to claim 1, wherein said primer coating is cured.

10. The conductive element according to claim 7, wherein said electrically conductive particles of said primer coating are selected from the group consisting of: gold, platinum, nickel, tin, silver, palladium, noble metals, graphite, carbon black, and mixtures thereof.

11. The conductive element according to claim 10, wherein said electrically conductive particles comprise graphite and carbon black.

12. The conductive element according to claim 11, wherein said graphite is selected from the group consisting of: expanded graphite, graphite powder, graphite flakes, and mixtures thereof.

13. The conductive element according to claim 11 above, wherein said total amount of graphite and carbon combined are present in said matrix at less than about 10 % by weight.

14. The conductive element according to claim 1, wherein said electrically conductive adhesive is partially cured.

15. The conductive element according to claim 1, wherein said electrically conductive adhesive comprises an adhesive polymer and a plurality of electrically conductive particles.

16. The conductive element according to claim 15, wherein said adhesive polymer comprises polyamide imide.

17. The conductive element according to claim 15, wherein said adhesive polymer is selected from the group consisting of: elastomers, pressure sensitive adhesives, thermoset adhesives, and mixtures thereof.

18. The conductive element according to claim 15, wherein said adhesive polymer has a glass transition temperature (T_g) of less than about -20°C.

19. The conductive element according to claim 18 above, wherein said adhesive polymer is selected from the group consisting of: ethylene, propylene, butylene, ethylene propylene dimer (EPDM), ethylene propylene monomer (EPM), polyethylene, polypropylene, polybutylene, isobutylene, acrylonitrile butadiene styrene, styrene butadiene rubber, butadiene rubber, nitride rubber, epoxy, urethane, acrylics, silicones, phenolics, novolacs, polymethyl methacrylates, and mixtures thereof.

20. The conductive element according to claim 15, wherein said electrically conductive particles of said electrically conductive adhesive are selected from the group consisting of: gold, platinum, nickel, tin, silver, palladium, noble metals, graphite, carbon black, and mixtures thereof.

21. The conductive element according to claim 1 wherein said first and said second coated surfaces are joined to one another at said one or more contact regions by an electrically conductive adhesive which forms a fluid-tight seal.

22. An electrically conductive contact element for a PEM fuel cell, said element comprising:

a first sheet having a first contact surface overlaid with an electrically conductive adhesive primer coating;

a second sheet having a second contact surface overlaid with said electrically conductive adhesive primer coating;

one of more bond regions joining said first contact surface and said second contact surface; said bond regions having an electrical resistance of less than 5 mOhms-cm^2 after 500 hours of operation in fuel cell operating conditions.

23. An electrically conductive contact element comprising:

a first sheet having a first contact surface overlaid with an electrically conductive adhesive primer coating;

a second sheet having a second contact surface overlaid with said electrically conductive adhesive primer coating;

an electrically conductive adhesive disposed between said first contact surface and said second contact surface in electrical contact regions; and

wherein said electrically conductive adhesive primer coating comprises graphite, carbon black, and a polymeric binder and said total amount of graphite and carbon combined are present in said matrix at less than about ten percent by weight.

24. A fuel cell stack comprising a plurality of fuel cells and an electrically conductive element sandwiched between an anode and cathode of adjacent fuel cells comprising:

a first electrically conductive sheet having an anode confronting surface and a first heat exchange surface;

a second electrically conductive sheet having a cathode confronting surface and a second heat exchange surface;

wherein said first and second heat exchange surfaces are coated with a primer coating comprising a first plurality of electrically conductive particles dispersed in a corrosion resistant polymer; said first and second heat exchange surfaces confronting each other so as to define therebetween a coolant flow passage adapted to receive a liquid coolant and being electrically coupled to one another at a plurality of sites via an electrically conductive adhesive, said electrically conductive adhesive comprising a second plurality of conductive particles dispersed in a polymer having adhesive properties; and

wherein said primer coating and said electrically conductive adhesive together define an electrically conductive path between said first and second sheets.

25. A fuel cell stack of claim 24 wherein an electrical resistance across said electrically conductive path is sufficiently low such that current generated by

the anode and cathode is conducted therefrom at a rate sufficient to prevent overheating of said coolant.

26. The fuel cell stack of claim 25 wherein an electrical resistance across said electrically conductive path is sufficiently low such that stack voltage loss due to bondline resistance is less than 5% of the power generated by the stack.

27. The fuel cell stack according to claim 24, wherein said primer coating has a contact resistance of less than 20 mOhms-cm^2 at 200 psi.

28. The fuel cell stack according to claim 24, wherein said adhesive and said primer coating together form a fluid-tight seal.

29. A method of increasing bond durability of an electrically conductive element in a fuel cell, the method comprising:

coating a first surface of a first sheet and a second surface of a second sheet with an electrically conductive adhesive primer;

disposing an electrically conductive adhesive between said first and second coated surfaces; thereby joining said first and said second coated surfaces together; wherein said adhesive is selected for sustained sealing engagement with the adhesive primer applied on said first and said second surfaces.

30. The method according to claim 29, wherein said adhesive is disposed in a quantity sufficient to provide a fluid-tight seal between said first and second surfaces.

31. The method according to claim 29, wherein after said joining said adhesive is cured.

32. The method according to claim 29, wherein after said joining said adhesive is partially cured.

33. The method according to claim 29, wherein prior to said disposing said adhesive primer is cured.

34. The method according to claim 29, wherein said coating is conducted by brushing, spraying, spreading, laminating, screen printing, or powder coating.

35. The method according to claim 29, wherein said disposing is achieved by coating said first surface.

36. The method according to claim 29, wherein said disposing is achieved by coating said first and said second surfaces.

37. The method according to claim 29 above, wherein said disposing is conducted by brushing, dabbing, spraying, or rolling said adhesive on either of said first surface or said second surface, or both of said surfaces.

38. The method according to claim 29, wherein said joining is conducted by applying pressure to said first and second coated surfaces, having said adhesive disposed therebetween.